Section 5.3 Noise and Vibration

This section describes the potential noise and vibration impacts associated with the proposed changes to the approved project. This section supplements Section 4.14 of the 2005 Final EIR, Section 5.13 of the 2007 Final SEIR, and Section 3.12 of the 2014 Subsequent IS/MND. This analysis is based on and supported by the September 21, 2018 *EBRC – CELR Noise and Vibration Assessment* prepared by ATS Consulting (included in Attachment E). Mitigation measures are identified for impacts that exceed the significance thresholds included in the 2005 Final EIR.

Environmental Setting

The existing noise environment along the Capitol Expressway corridor is dominated by traffic. Capitol Expressway is an eight-lane facility with six mixed-flow lanes and two carpool lanes. The ambient noise environment within the corridor was measured at four locations in December 2017 to supplement previous noise surveys prepared for the approved project in 2001, 2006, and 2010. A Federal Highway Administration Traffic Noise Model was developed to accurately compare previous and current noise measurements and to estimate the noise at each sensitive receptor due to traffic noise along Capitol Expressway. The existing (2017) noise exposure level ranges from 66.3 to 74.1 L_{dn}, compared to a range of 65 to 73 L_{dn} in 2010, when the most recent noise survey was prepared for the approved project.

The applicable noise and vibration regulations remain unchanged since the 2014 Subsequent IS/MND.

Environmental Impacts and Mitigation

The impact discussion in this section primarily focuses on the proposed changes to the approved project that could result in new or more significant noise and vibration impacts compared to the impacts previously identified and analyzed for the approved project.

The majority of the proposed changes to the approved project (including the modifications to the Eastridge Station platforms and tracks; reduction in parking spaces at the Eastridge Park-and-Ride lot; minor shift in the location and straightening of the Story Station pedestrian overcrossing and access; modification to Story Station pedestrian access; relocation of a construction staging area; and relocation of PG&E electrical transmission facilities) would not result in changes to noise and vibration compared to the impacts previously identified and analyzed for the approved project.

Two proposed changes to the approved project (the extension of the aerial guideway to grade-separate the Ocala Avenue and Cunningham Avenue intersections and revisions to Capitol Expressway roadway lane configurations) would affect noise and vibration levels at sensitive receivers (e.g., residences) located adjacent to the proposed changes to the approved project. As with the approved project, the proposed changes would involve the operation of light rail primarily within the median of Capitol Expressway. However, the

proposed change would replace the at-grade track alignment with approximately 1.25 miles of aerial guideway from south of Story Road to north of Tully Road. The aerial guideway would include concrete columns supported on pile foundations and aerial guideway sound walls. The proposed changes to the approved project would also include resurfacing Capitol Expressway with open-graded asphalt concrete (OGAC).[1] Both of the existing high-occupancy vehicle lanes (one northbound and one southbound) would be converted to general purpose traffic lanes, resulting in a total of four general purpose lanes in each direction between Story Road and Capitol Avenue as a result of the proposed revisions to Capitol Expressway roadway lane configurations. These proposed changes to the approved project could result in new or more significant noise and vibration impacts compared to the impacts previously identified for the approved project.

NOISE LEVELS FROM TRANSIT OPERATION

Table 5.3-1 summarizes the anticipated operational transit noise impacts generated by the proposed changes to the approved project in 2017 and 2043. The table indicates the number of impacts for both years under the following conditions:

- Without the proposed aerial guideway sound walls and without the proposed OGAC;
- With only the proposed aerial guideway sound walls; and
- With both the proposed aerial guideway sound walls and the proposed OGAC.

A more detailed list of anticipated pile driving vibration impacts can be found in Table 9 of the September 21, 2018 *EBRC – CELR Noise and Vibration Assessment* (included in Attachment E).

Impact: The September 21, 2018 *EBRC – CELR Noise and Vibration Assessment* indicates that the proposed changes to the approved project would result in 78 moderate and 23 severe noise impacts in 2017 without the proposed aerial guideway sound walls and without the proposed OGAC. The proposed changes would result in 96 moderate and 59 severe noise impacts in 2043 without the proposed aerial guideway sound walls and without the proposed OGAC. The location of receivers where pile driving vibration impacts are predicted are as follows:

- Twenty-three properties located east and west of the alignment between Wilbur Avenue and Mervyns Way would experience one severe and twenty-two moderate noise impacts.
- Twenty-five properties located west of the alignment between Excalibur Drive and Story Road would experience moderate noise impacts.

[1] Recent studies by Caltrans indicate that OGAC produces noticeably less vehicle noise than other pavement types (i.e., concrete and conventional asphalt).

- Two commercial properties located west of the alignment near the intersection of Story Road and Expressway would experience moderate noise impacts.
- Forty-one properties located east of the alignment between Story Road and Ocala Avenue would experience thirty-eight moderate and three severe noise impacts.
- Seventeen properties located west of the alignment between Story Road and Foxdale Loop would experience four moderate and thirteen severe noise impacts.
- One commercial property located west of the alignment near the intersection of Foxdale Loop and Capitol Expressway would experience a moderate noise impact.
- Twenty-seven properties located east of the alignment between Ocala Avenue and Cunningham Avenue would experience severe noise impacts.
- Nineteen properties located west of the alignment between Foxdale Drive and Ocala Avenue would experience four moderate and fifteen severe noise impacts.

With only the proposed aerial sound walls, the proposed changes would result in 45 moderate and 0 severe noise impacts in 2017 as well as 116 moderate and 0 severe noise impacts in 2043. With both the proposed aerial guideway sound walls and the proposed OGAC, all moderate and severe impacts would be eliminated in 2017 and 2043. For sensitive receivers where a moderate impact is anticipated, VTA does not require mitigation measures under CEQA.

The following impact from the 2005 Final EIR would still apply to the proposed changes to the approved project: NV-1 (Noise Levels from Transit Operations That Would Be Considered a Severe Impact by Federal Transit Administration Criteria).

Mitigation: The following mitigation measures identified in the 2005 Final EIR and the 2007 Final SEIR would still apply to the proposed changes to the approved project: NV-1a (Construct Soundwalls) and NV-1c (Provide Quiet Pavement). Mitigation Measure NV-1b is no longer needed as a rest of project changes.

Inclusion of these mitigation measures would reduce these impacts to "Less than Significant."

Less-than-significant impact with mitigation.

Table 5.3-1 Summary of Existing (2017) and Year 2043 Operational Transit Noise Impacts Associated with the Proposed Changes to the Approved Project

Segment of Capitol Expressway	Number – Type of Receivers[1]	Existing (2017) Noise (Ldn)[2]	Without Aerial Guideway Sound Wall & OGAC[3] Year 2043 (Year 2017)[4]		With Aerial Guideway Sound Wall Year 2043 (Year 2017)[4]		With Aerial Guideway Sound Wall & OGAC[3] Year 2043 (Year 2017)[4]	
			Moderate	Severe	Moderate	Severe	Moderate	Severe
NB 964+50 to 981+20 Wilbur Ave. to Mervyns Way	22 - SFR	70-78	18 (12)	1 (0)	0 (0)	0 (0)	0 (0)	0 (0)
NB 986+70 to 995+50 Mervyns Way to Story Road	5 – INST/COM	72-73	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
NB 998+50 to 1035+90 Story Road to Ocala Avenue	41 - SFR	68-75	38 (5)	3 (0)	28 (3)	0 (0)	0 (0)	0 (0)
NB 1037+60 to 1049+50 Ocala Avenue to Cunningham Avenue	27 - SFR	65-67	0 (6)	27 (21)	27 (27)	0 (0)	0 (0)	0 (0)
SB 967+50 to 970+50 S Capitol Avenue	5 - SFR	67-73	4 (0)	0 (0)	1 (0)	0 (0)	0 (0)	0 (0)
SB 971+30 to 973+00 S Capitol Avenue	2 - COM	71-74	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
SB 978+00 to 992+70 Excalibur Drive to Story Road	25 - SFR	72-75	25 (21)	0 (0)	23 (14)	0 (0)	0 (0)	0 (0)
SB 993+10 to 996+50 Story Road	3 - COM	73-74	2 (0)	0 (0)	2 (0)	0 (0)	0 (0)	0 (0)

Segment of Capitol Expressway	Number – Type of Receivers[1]	Existing (2017) Noise (Ldn)[2]	Without Aerial Guideway Sound Wall & OGAC[3] Year 2043 (Year 2017)[4]		With Aerial Guideway Sound Wall Year 2043 (Year 2017)[4]		With Aerial Guideway Sound Wall & OGAC[3] Year 2043 (Year 2017)[4]	
			Moderate	Severe	Moderate	Severe	Moderate	Severe
SB 998+80 to 1007+20 Story Road to Foxdale Loop	17 - SFR	65-73	4 (16)	13 (1)	16 (0)	0 (0)	0 (0)	0 (0)
SB 1009+00 E. Capitol Expressway	1 - COM	74	1 (0)	0 (0)	1 (0)	0 (0)	0 (0)	0 (0)
SB 1012+00 to 1018+00 Foxdale Loop	3 - MFR	69	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
SB 1021+00 to 1035+80 Foxdale Drive to Ocala Avenue	19 - SFR	65-67	4 (18)	15 (1)	18 (1)	0 (0)	0 (0)	0 (0)
Number of Impacts:			**96 (78)**	**59 (23)**	**116 (45)**	**0 (0)**	**0 (0)**	**0 (0)**

Notes:

[1] Receiver types include: Single-Family Residence (SFR), Multi-Family Residence (MFR), Commercial/Office Space (COM), and Institutional (INST).

[2] Day-Night Sound Level (Ldn) is the most common measure of total community noise over a 24-hour period and is used by the FTA to evaluate residential noise impacts from proposed transit projects.

[3] Open-graded asphalt concrete (OGAC) is a noise-reducing pavement surface.

[4] Moderate and severe impacts were determined according to FTA *Noise and Vibration Impact Assessment Guidance Manual* (2006).

Source: ATS Consulting, 2018.

VIBRATION LEVELS FROM TRANSIT OPERATION

Table 5.3-2 summarizes the anticipated operational transit vibration impacts generated by the proposed changes to the approved project. There is no distinction between the number of impacts anticipated in 2017 and 2043 because vibration criteria are not based on cumulative increases in vibration levels (as is the case with noise). The table indicates the number of impacts under the following conditions:

- Without any mitigation; and
- With inclusion of mitigation consisting of only tire derived aggregate (TDA).

Table 5.3-2 Summary of Operational Transit Vibration Impacts Associated with the Proposed Changes to the Approved Project

Direction/Segment of Capitol Expressway	Number – Type of Receivers[1]	Impact Criteria (VdB)[2]	Unmitigated[4]	With TDA[4,5]
NB 964+50 to 981+20 Wilbur Avenue to Mervyns Way	22 – SFR	72 - 78	14	14
NB 986+70 to 995+50 Mervyns Way to Story Road	5 – INST/COM	78-84[3]	0	0
NB 998+50 to 1035+90 Story Road to Ocala Avenue	41 – SFR	72 - 78	4	4
NB 1037+60 to 1049+50 Ocala Avenue to Cunningham Avenue	27 – SFR	72 - 78	21	21
SB 967+50 to 970+50 S. Capitol Avenue	5 – SFR	72 - 78	3	2
SB 971+30 to 973+00 S. Capitol Avenue	2 – COM	84[3]	0	0
SB 978+00 to 992+70 Excalibur Drive to Story Road	25 – SFR	72 - 78	2	2
SB 993+10 to 996+50 Story Road	3 – COM	84[3]	0	0
SB 998+80 to 1007+20 Story Road to Foxdale Loop	17 – SFR	72 - 78	15	15
SB 1009+00 E. Capitol Expressway	1 – COM	84[3]	0	0
SB 1012+00 to 1018+00 Foxdale Loop	3 – MFR	72 - 78	0	0
SB 1021+00 to 1035+80 Foxdale Drive to Ocala Avenue	19 – SFR	72 - 78	14	14
		Number of Impacts:	**73**	**72**

Notes:

[1] Receiver types include: Single-Family Residence (SFR), Multi-Family Residence (MFR), Commercial/Office Space (COM), and Institutional (INST).

[2] FTA nighttime impact criteria of 72 vibration decibels (VdB) and daytime of 78 VdB.

[3] Impact threshold for offices and non-sensitive areas.

[4] Impacts were determined according to FTA *Noise and Vibration Impact Assessment Guidance Manual* (2006).

[5] Tire derived aggregate (TDA) is a resilient underlayment for ballasted track that would only be located at the at-grade and embankment sections.

Source: ATS Consulting, 2018.

Impact: The September 21, 2018 *EBRC – CELR Noise and Vibration Assessment* indicates that the proposed changes to the approved project would result in exceedances of the Federal Transit Administration (FTA) nighttime (10:00 pm to 7:00 am) vibration impact criteria at sensitive receivers located within 100 feet of the proposed aerial guideway. Most of the impacts are anticipated to occur between 6:00 am and 7:00 am when VTA would be operating at peak service levels. The proposed aerial guideway (direct fixation fasteners) and ballasted track on embankment sections would cause an exceedance of the nighttime impact criteria at 73 sensitive receiver locations. The location of receivers where operational vibration impacts are predicted are as follows:

- Seventeen properties located east and west of the alignment, between Wilbur Avenue and Mervyns Way would experience operational vibration impacts. One home is within 33 feet of the closest support column.
- Two properties located west of the alignment on Capitol Expressway near Story Road would experience operational vibration impacts.
- Fifteen properties located west of the alignment along Brenford Drive would experience operational vibration impacts.
- Fourteen properties located west of the alignment between Foxdale Drive and Ocala Avenue would experience operational vibration impacts.
- Four properties located east of the alignment between South Capitol Avenue and Ocala Avenue would experience operational vibration impacts.
- Twenty-one properties located east of the alignment between Ocala Avenue and Cunningham Avenue would experience operational vibration impacts.

No daytime vibration impacts are anticipated under current train parameters, schedules, headways, and speeds.

The following impact from the 2005 Final EIR would still apply to the proposed changes to the approved project: NV-4 (Vibration Levels in Buildings from Transit Operations That Exceed Federal Transit Administration Criteria).

Mitigation: The following mitigation measure identified in the 2005 Final EIR and 2007 Final SEIR would still apply to the proposed changes to the approved project: NV-4b (Use Vibration-Dampening Track Construction Materials). With inclusion of TDA, vibration would exceed the nighttime impact criteria at 72 sensitive receiver locations at the at-grade and embankment sections of the alignment.

If a 5-Hertz floating slab track (FST) or a bridge bearing vibration isolation system[2] is included as mitigation, the nighttime impact criteria would not be exceeded at any sensitive receptor locations. In addition, reducing train speed typically results in lower groundborne vibration levels. Specifically, if speeds are reduced from 55 mph to 35 mph between 10:00 pm and 7:00 am, the nighttime impact criteria would not be exceeded at any sensitive receptor locations.

VTA is not recommending to include FST or a bridge bearing isolation system as mitigation for several reasons. Future vibration levels, which include a +3 VdB safety factor, are at or slightly above the nighttime vibration impact criteria at many impacted locations, and may not actually exceed the threshold in operation. Many impacted locations are up to 100 feet from the aerial guideway, which is much farther than the typical distance at which nighttime vibration impacts are experienced. In addition, it is VTA's understanding that FST has not been installed on any aerial guideways in the United States and a bridge bearing isolation system has only been recently installed on one aerial structure in the United States. VTA is only aware of one example of FST installed on an aerial guideway on Hong Kong's KCRC West Rail and of one example of a bridge bearing vibration isolation system installed on an aerial structure at Miami Central Station, on the All Aboard Florida-Brightline network. Thus, there is limited information on the effectiveness of FST and bridge bearing isolation systems on aerial structures.

VTA is also not proposing to include speed reduction as mitigation because it would negatively affect travel time and operations between 10:00 pm and 7:00 am.

By not including FST; a bridge bearing vibration isolation system; or implementing speed reductions as mitigation, and because TDA is the only feasible mitigation option to reduce vibration levels from

[2] A bridge bearing vibration isolation system is a system in which resilient bridge bearings are designed and function like the springs or rubber pads that support floating slab track.

operation, this impact would be "Significant and Unavoidable." Based on the analysis above, the proposed changes to the approved project would result in new significant impacts related to vibration levels from transit operation. With inclusion of TDA, vibration impacts are expected to occur at 72 sensitive receivers under the proposed changes to the approved project. This is an increase of 20 sensitive receivers compared to the 2005 Final EIR, which concluded 52 sensitive receivers would be potentially exposed to vibration impacts during operation.

Significant and unavoidable impact, even with mitigation.

PILE DRIVING NOISE IMPACTS DURING CONSTRUCTION

During construction, pile driving would be conducted to install foundation piles for the proposed aerial guideway. Table 5.3-3 summarizes the anticipated pile driving noise impacts generated by the proposed changes to the approved project during construction. The table indicates the number of impacts under the following conditions:

- Without any mitigation;
- With inclusion of mitigation consisting of impact cushions, which involves initially using burlap bags and then adding wood block when pile driving becomes more difficult;
- With inclusion of mitigation consisting of both impact cushions and pre-drilling, which involves pre-drilling 1/3 of a pile to reduce the total duration of impact time; and
- With inclusion of mitigation consisting of both impact cushions and noise shields around the pile equipment, which consists of a frame that secures acoustic blankets or paneling.

A more detailed list of anticipated pile driving noise impacts can be found in Table 14 of the September 21, 2018 *EBRC – CELR Noise and Vibration Assessment* (included in Attachment E).

Table 5.3-3 Summary of Construction Pile Driving Noise Impacts Associated with the Proposed Changes to the Approved Project

Direction/Segment of Capitol Expressway	Number – Type of Receivers[1]	Federal Transit Administration Impact Criteria Leq (8-hr) dBA[2]	Unmitigated[3]	With Impact Cushions[3]	With Impact Cushions & Pre-Drilling[3,5]	With Impact Cushions[3] & Noise Shields[3,6]
NB 964+50 to 981+20 Wilbur Avenue to Mervyns Way	22 – SFR	80	15	11	9	2
NB 986+70 to 995+50 Mervyns Way to Story Road	5 – INST/COM	80/85	5	3	2	0
NB 998+50 to 1035+90 Story Road to Ocala Avenue	41 – SFR	80	41	40	25	0
NB 1037+60 to 1049+50 Ocala Avenue to Cunningham Avenue	27 – SFR	80	27	22	9	0
SB 967+50 to 970+50 S. Capitol Avenue	5 – SFR	80	2	0	0	0
SB 971+30 to 973+00 S. Capitol Avenue	2 – COM	85	2	2	1	0
SB 978+00 to 992+70 Excalibur Drive to Story Road	25 – SFR	80	21	21	21	0
SB 993+10 to 996+50 Story Road	3 – COM	85	3	1	0	0
SB 998+80 to 1007+20 Story Road to Foxdale Loop	17 – SFR	80	17	12	2	0
SB 1009+00 E. Capitol Expressway	1 – COM	85	1	1	0	0

Direction/Segment of Capitol Expressway	Number – Type of Receivers[1]	Federal Transit Administration Impact Criteria Leq (8-hr) dBA[2]	Unmitigated[3]	With Impact Cushions[3]	With Impact Cushions & Pre-Drilling[3,5]	With Impact Cushions[3] & Noise Shields[3,6]
SB 1012+00 to 1018+00 Foxdale Loop	3 – MFR	80	3	3	0	0
SB 1021+00 to 1035+80 Foxdale Drive to Ocala Avenue	19 – SFR	80	19	19	11	0
		Number of Impacts:	**156**	135	80	2

Notes:

[1] Receiver types include: Single-Family Residence (SFR), Multi-Family Residence (MFR), Commercial/Office Space (COM), and Institutional (INST).

[2] Day-Night Sound Level (Ldn) is the most common measure of total community noise over a 24-hour period and is used by the Federal Transit Administration (FTA) to evaluate residential noise impacts from proposed transit projects.

[3] Impacts were determined according to FTA's *Noise and Vibration Impact Assessment Guidance Manual* (2006).

[4] An impact cushion is a type of mitigation that involves initially using burlap bags and then adding wood block when pile driving becomes more difficult.

[5] Pre-drilling is a type of mitigation that consists of pre-drilling 1/3 of a pile to reduce the total duration of impact time.

[6] A noise shield is a type of mitigation that consists of a frame that secures acoustic blankets or paneling.

Source: ATS Consulting, 2018.

Impact: The September 21, 2018 *EBRC – CELR Noise and Vibration Assessment* indicates that the proposed changes to the approved project would result in exceedances of the FTA construction noise impact criteria at unobstructed homes and businesses (i.e., homes and businesses not shielded by other structures or sound walls) within 300 feet of pile driving activity. The noise impacts would have a duration of 8 to 15 days per sensitive receiver. Pile driving would exceed the construction noise impact criteria of 80 Leq at residences and 85 Leq at commercial properties at 156 sensitive receiver locations. The location of receivers where pile driving noise impacts are predicted are as follows:

- Fifteen residential properties located east of the alignment between Wilbur Avenue and Mervyns Way would experience construction noise impacts. One home is within 25 feet of the closest pile.
- Five institutional/commercial properties located east of the alignment between Mervyns Way and Story Road would experience construction noise impacts.
- Forty-one residential properties located east of the alignment between Story Road and Ocala Avenue would experience construction noise impacts.
- Twenty-seven residential properties located east of the alignment between Ocala Avenue and Cunningham Avenue would experience construction noise impacts.
- Two residential properties located west of the alignment along South Capitol Avenue would experience construction noise impacts.
- Two commercial properties located west of the alignment along South Capitol Avenue would experience construction noise impacts.
- Twenty-one residential properties located west of the alignment between Excalibur Drive and Story Road would experience construction noise impacts.
- Three commercial properties located west of the alignment near the intersection of Capitol Expressway and Story Road would experience construction noise impacts.
- Seventeen residential properties located west of the alignment between Story Road and Foxdale Loop would experience construction noise impacts.
- One commercial property located west of the alignment near the intersection of Capitol Expressway and Foxdale Loop would experience a construction noise impact.

- Three residential properties located west of the alignment along Foxdale Loop would experience construction noise impacts.
- Nineteen residential properties located west of the alignment between Foxdale Drive and Ocala Avenue would experience construction noise impacts.

The proposed changes to the approved project would result in an increase in the number of construction noise impacts compared to the 2007 Final SEIR due to an increase in the number of foundation piles associated with changing the at-grade track under the approved project to an aerial guideway under the proposed changes.

The following impact from the 2005 Final EIR would still apply to the proposed changes to the approved project: NV (CON)-1: (Generation of Noise or Vibration That Substantially Affects Nearby Sensitive Receptors).

Mitigation: The following mitigation measures identified in the 2005 Final EIR and the 2007 Final SEIR would still apply to the proposed changes to the approved project: NV (CON)-1a (Notify Residents of Construction Activities), NV (CON)-1b (Construct Temporary Noise Barriers During Construction), NV (CON)-1c (Restrict Pile Driving)[3], NV (CON)-1d (Use Noise Suppression Devices), NV (CON)-1e (Locate Stationary Construction Equipment as Far as Possible from Sensitive Receptors), NV (CON)-1f (Reroute Construction-Related Truck Traffic), NV (CON)-1g (Develop Construction Noise Mitigation Plan) and NV (CON)–2.

Mitigation Measure NV (CON)-2 has been modified.

Mitigation Measure NV (CON)-2

A combination of the following measures should be considered if reasonable and feasible to reduce noise and vibration impacts from pile driving:

1. Noise Shield: A pile driving noise shield could be effective at reducing the pile driving noise by a minimum 5 dBA, depending on the size of the shield and how well it surrounds the pile and hammer. A portable shield/barrier could be implemented to provide a nominal 10 dBA noise reduction.
2. Pre-Drilling Piles: Pre-drilling a portion of the hole may provide a means to reduce the duration of impact pile driving, and should be explored. Reducing the total impact time to an aggregate duration

[3] In the 2005 Final EIR, this measure restricts pile driving to the hours of 8:00 am to 5:00 pm. To be consistent with the San Jose municipal code, these hours are revised to 7:00 am to 7:00 pm, Monday through Friday.

of no more than 2 hours per day will reduce the equivalent noise level by 6 dBA to a range of 80 to 90 dBA (L_{eq}) at a distance of 100ft.

3. Non-Impact Piles or Cast in Drilled Hole (CIDH) piles: Using the Soil-Mix or CIDH method would reduce the vibration below the FTA Criteria. This method is recommended for homes which would be within 75 ft of pile driving.
4. Reduced Impact Pile Driving Time: Limiting the hours per day of impact pile driving would reduce the equivalent noise level and would reduce potential work interference.
5. Excessive Vibration: If pile driving amplitudes exceed the building threshold criteria, cosmetic repair work may be required at nearby buildings. A detailed preconstruction crack survey will be conducted at homes and businesses where these criteria are expected to be exceeded. Vibration monitoring, crack monitors and photo documentation will be employed at these locations during pile driving activity.
6. Relocating Items on Shelves: Since items on shelves and walls may move during pile driving activity, nearby residents will be advised through the community outreach process that they should move fragile and precious items off of shelves and walls for the duration of the impact pile driving. Achievement of standards for building damage would not eliminate annoyance, since the vibration would still be quite perceptible.
7. Advance Notification (Work Interference): The impact pile driving vibration may cause interference with persons working at home or the office on their computers. Nearby residents and businesses will be advised in advance of times when piles would be driven, particularly piles within 160 ft of any occupied building, so that they may plan accordingly, if possible.
8. Notification of Pile Driving Schedule: Nearby residents and businesses will be notified of the expected pile driving schedule. In particular, these notifications should be made with home-bound residents, homes where there is day-time occupancy (e.g., work at home, stay-at-home parents) and offices/commercial businesses where extensive computer/video monitor work is conducted.
9. Hotel Accommodations: Residents at 660 South Capitol Avenue will be provided with hotel accommodations while pile driving activities occur adjacent to the residence.

Contractor Controls

In addition to the above list of specific noise and vibration control measures, the following are recommended for inclusion in the Contractor specifications for the Indicator and Production pile driving programs if reasonable and feasible:

- Comply with the equivalent noise levels (L_{eq}) limits specified on page 12-8 of FTA 2006 and a maximum noise level limits of 90 dBA (slow) or 125 dBC (fast) for residential buildings,
- Comply with the maximum vibration limits specified in Table 12-3 of FTA 2006,
- Perform a detailed survey and photo documentation prior to construction of all potentially affected wood-frame buildings within 135 ft of the piling activity,
- Coordinate and perform noise and vibration monitoring at a representative sampling of potentially affected buildings along the Project corridor,
- Install crack monitors where appropriate and provide photo documentation at all potentially affected buildings during pile driving activity and through construction,
- Community Notification and Involvement:
  - provide a minimum four-week advance notice of the start of piling operations to all affected receptors (e.g., internet, phone and fax), and regular, up-to-date communications. This includes education of the public on the expected noise and vibration,
  - provide a knowledgeable Community Liaison to respond to questions and complaints regarding pile driving noise and vibration, and
  - provide assistance as needed to nearby residents or offices who may require help relocating valuable items off shelves.

Mitigation Measure NV (CON)-1h: Use Impact Cushions

A suitable pile cap cushion could be effective at reducing the pile driving noise by up to 5 dB. The construction crew will initially use only burlap bags to reduce noise and then will also use the wood block when pile driving becomes more difficult.

This new mitigation measure shall be implemented in addition to the measures identified in the Mitigation Monitoring and Reporting Plan (MMRP) prepared for the approved project.

With inclusion of impact cushions, pile driving would exceed the construction noise impact criteria at 135 sensitive receiver locations. With inclusion of impact cushions and pre-drilling, pile driving would exceed the construction noise impact criteria at 80 sensitive receiver locations. With inclusion of impact cushions and noise shields around the pile equipment, pile driving would exceed the construction noise impact criteria at 2 sensitive receiver locations. VTA is recommending to mitigate this impact with noise cushions and temporary noise barriers. Even with inclusion of these mitigation measures, this impact would be "Significant and Unavoidable." Based on the analysis above, the proposed changes to the approved project would result in new significant impacts related to pile driving noise impacts during construction.

Significant and unavoidable impact, even with mitigation.

PILE DRIVING VIBRATION IMPACTS DURING CONSTRUCTION

As discussed above, pile driving would be conducted to install foundation piles for the proposed aerial guideway. Table 5.3-4 summarizes the anticipated pile driving vibration impacts generated by the proposed changes to the approved project during construction. The table indicates the number of impacts under the following conditions:

- Without any mitigation; and
- With inclusion of mitigation consisting of non-impact piling (e.g., vibratory piling or cast-in-drilled-hole piling).

A more detailed list of anticipated pile driving vibration impacts can be found in Table 14 of the September 21, 2018 *EBRC – CELR Noise and Vibration Assessment* (included in Attachment E).

Table 5.3-4 Summary of Impact Pile Driving Vibration Impacts Associated with the Proposed Changes to the Approved Project

Direction/Segment of Capitol Expressway	Number – Type of Receivers[1]	Annoy. Criteria PPV[2, 3] (in/s)	Federal Transit Administration Damage Criteria PPV[2,4] (in/s)	Number of Anticipated Federal Transit Administration Impacts (Based on Damage Criteria)	
				Unmitigated	With CIDH Piling[5,6]
NB 964+50 to 981+20 Wilbur Avenue to Mervyns Way	22 - SFR	0.03	0.2	9	0

Direction/Segment of Capitol Expressway	Number – Type of Receivers[1]	Annoy. Criteria PPV[2, 3] (in/s)	Federal Transit Administration Damage Criteria PPV[2,4] (in/s)	Number of Anticipated Federal Transit Administration Impacts (Based on Damage Criteria)	
				Unmitigated	With CIDH Piling[5,6]
NB 986+70 to 995+50 Mervyns Way to Story Road	5 – INST/COM	0.06	0.5	0	0
NB 998+50 to 1035+90 Story Road to Ocala Avenue	41 - SFR	0.03	0.2	5	0
NB 1037+60 to 1049+50 Ocala Avenue to Cunningham Avenue	27 - SFR	0.03	0.2	21	0
SB 967+50 to 970+50 S. Capitol Avenue	5 - SFR	0.03	0.2	0	0
SB 971+30 to 973+00 S. Capitol Avenue	2 - COM	0.06	0.5	0	0
SB 978+00 to 992+70 Excalibur Drive to Story Road	25 - SFR	0.03	0.2	0	0
SB 993+10 to 996+50 Story Road	3 - COM	0.06	0.5	0	0
SB 998+80 to 1007+20 Story Road to Foxdale Loop	17 - SFR	0.03	0.2	15	0
SB 1009+00 E. Capitol Expressway	1 - COM	0.03	0.5	0	0
SB 1012+00 to 1018+00 Foxdale Loop	3 - MFR	0.03	0.2	0	0
SB 1021+00 to 1035+80 Foxdale Drive to Ocala Avenue	19 - SFR	0.03	0.2	14	0
			Number of Impacts:	**64**	**0**

Notes:

[1] Receiver types include: Single-Family Residence (SFR), Multi-Family Residence (MFR), Commercial/Office Space (COM), and Institutional (INST).

[2] Annoyance criteria based on an equivalent PPV to RMS value of 78 VdB for SFR/MFR and 84 VdB for COM, assuming a crest factor of 4.

[3] Peak particle velocity (PPV).

[4] Damage criteria based on FTA *Noise and Vibration Impact Assessment Guidance Manual* (2006).

[5] Cast in drilled hole piles (CIDH). If vibratory driven piles are used, one impact would remain at NB 977+70 (660 S. Capitol Ave.)

[6] The use of CIDH pile driving would theoretically reduce the total number of impacts to zero if used throughout construction; however, CIDH pile driving may not be feasible in all cases.

Source: ATS Consulting, 2018.

Impact: The September 21, 2018 *EBRC – CELR Noise and Vibration Assessment* indicates that the proposed changes to the approved project would result in exceedances of the FTA nighttime construction vibration of 0.2 PPV impact criteria at homes within 100 feet of pile driving activity. Pile driving would exceed the construction vibration impact criteria at 64 sensitive receiver locations. The location of receivers where pile driving vibration impacts are predicted are as follows:

- Nine properties located east of the alignment between Wilbur Avenue and Mervyns Way would experience construction vibration impacts. One home is within 25 feet of the closest pile.
- Five properties located east of the alignment between Story Road and Ocala Avenue would experience construction vibration impacts.
- Twenty-one properties located east of the alignment between Ocala Avenue and Cunningham Avenue would experience construction vibration impacts.
- Fifteen properties located west of the alignment between Story Road and Foxdale Loop would experience construction vibration impacts.
- Fourteen properties located west of alignment between Foxdale Drive and Ocala Avenue would experience construction vibration impacts.

The following impact from the 2005 Final EIR would still apply to the proposed changes to the approved project: NV (CON)-1: (Generation of Noise or Vibration That Substantially Affects Nearby Sensitive Receptors).

Mitigation: The following mitigation measures identified in the 2005 Final EIR and the 2007 Final SEIR would still apply to the proposed changes to the approved project: NV (CON)-1a (Notify Residents of Construction Activities), NV (CON)-1c (Restrict Pile Driving), NV (CON)-1e (Locate Stationary Construction Equipment as Far as Possible from Sensitive Receptors) and NV (CON)-2.

VTA is not recommending the use of non-impact piling methods at any locations for a couple of reasons. Most locations are only slightly above the FTA Damage Criteria, and therefore may not experience any actual impacts due to the +3 VdB safety factor included to estimate construction vibration levels. At the locations with the highest construction vibration levels, structural damage is not anticipated to occur. As a result, VTA is not recommending to use non-impact piling

methods at any locations. Thus, this impact would be "Significant and Unavoidable."

No mitigation proposed. Significant and unavoidable impact.